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(54) DISPENSING DEVICE

- (71) We, PHILIPS ELECTRONIC AND ASSOCIATED INDUSTRIES LIMITED, of Abacus House, 33 Gutter Lane, London, E.C.2, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement: —
- The invention relates to a device for continuous by dispensing a liquid at an accurately determined, very low rate comprising a rotor surrounded by a housing and coupled to a driving mechanism, the rotor and the housing having cooperating surfaces in one of which at least one helical pumping groove is formed. Dispensing devices of this type are known. They are used, for example, in micro-analysis and in the automation of chemical analyses. The quantities to be dispensed are very small, ranging, for example, from 30 cm³ per second to quantities smaller than 1 mm³ per second. The liquid is forced to the pump outlet upon rotation of the rotor by the viscous forces occurring in the helically extending pumping groove or grooves. It will be obvious that with the very small quantities of liquid being dispensed and the great accuracy desired, it is of importance to maintain the pressure on the inlet side of the pump as constant as possible.
- According to the invention there is provided a device for continuously dispensing a liquid at an accurately determined, very low rate, comprising a rotor surrounded by a housing and coupled to a driving mechanism, the rotor and the housing having cooperating surfaces in one of which at least one helical pumping groove is formed, wherein the device is constructed to operate with the axis of the rotor in a vertical position, one end of the housing being closed by a wall having an outlet aperture and the other end opening into an auxiliary container for the liquid to be dispensed, which container has an air inlet and is arranged to lie above the rotor housing when the device is positioned for use and comprises a cover plate incorporating first and second tubes which are arranged to extend downwards into the auxiliary container when the device is positioned for use, the first tube extending further into the container than the second tube and the latter being wider than the first tube, and the end of the second tube that is situated in the auxiliary container being constructed so that its edge lies in a plane which is inclined to the horizontal when the device is positioned for use, and means being provided for connecting the two tubes to a closed container for the liquid to be dispensed.
- The closed container for the liquid may be constituted by a bottle in which the liquid can be supplied by the supplier. Such a bottle would only require a stopper which has two apertures to which can be connected the first and second tubes of the dispensing device. The driving mechanism may be constituted by an electric motor arranged on the cover plate and coupled to the rotor by a flexible shaft. With a flexible shaft, no great accuracy is required in the alignment of the rotor housing and the motor. Also it is possible to tilt the assembly consisting of the motor, shaft and rotor, which facilitates assembly and dismantling. In one embodiment of the invention the surface of the rotor which cooperates with the housing is frusto-conical. By slightly lifting this rotor and lowering it again, any air inclusions in the liquid can be removed. An additional advantage of a frusto-conical rotor is that it can be manufactured from a synthetic material in a self-releasing mould.
- In order to prevent the liquid, which is sometimes of an aggressive nature, from splashing out of the auxiliary container on to the motor, the driving shaft, which passes through the cover plate, comprises between the cover plate and the driving mechanism a dish-like plate of which the rim is directed towards the cover plate.
- In order that the invention may be readily carried into effect, a device constructed in accordance with the invention

will now be described with reference to the accompanying drawing, which is a sectional elevation of the device positioned for use.

5 The device shown in the drawing comprises a rotor 1 of frusto-conical shape. The rotor 1 is surrounded by a housing 2 of corresponding shape which is closed at the lower end by a wall 3 having an outlet aperture 4. The housing 2 is formed in its inner surface with a plurality of helical pumping grooves (not shown) of known form.

10 An auxiliary container 5 having a cover plate 6 is connected to the upper end of the housing 2. Incorporated in the cover plate 6 are a first tube 7 which extends almost down to the bottom of the auxiliary container and a second tube 8 which terminates at a higher level in the auxiliary container. The edge of the lower end 9 of the second tube 8 lies in a plane which is inclined to the horizontal. The tube 8 is wider than the tube 7 and tapers towards its upper end.

25 The cover plate 6 has a seating 10 on which an electric motor 11 is arranged. This electric motor 11 is connected to the rotor 1 by a flexible shaft 12.

30 A dish-like plate 13 of which the rim 14 is directed towards the cover plate 6 is provided on the shaft 12, which passes through the cover plate. Air enters the auxiliary container 5 through an annular gap between the plate 13 and the cover plate 6. The tubes 7 and 8 communicate via ducts 16 and 17, respectively, with two connections 18 and 19 in a stopper 20 of a bottle 21 which is arranged upside down and contains the liquid to be dispensed.

40 The operation of this dispensing device is as follows. Upon rotation of the rotor 1 by means of the electric motor 11, liquid is pumped from the container 5 to the outlet 4 by the viscous forces occurring in the helical grooves in the rotor housing 2. 55 When the liquid level in the container 5 falls below the highest point of the lower end 9 of the tube 8, air from the container 5 flows to the bottle 21 so that the negative pressure above the liquid in the bottle is reduced below the value which corresponds to the hydrostatic pressure equilibrium between the bottle 21 and the container 5. 50 As a result of this, liquid flows from the bottle 21 via duct 16 and tube 7 into the container 5 until the liquid level again closes the lower end 9 of the tube 8. In this manner a substantially constant liquid level is maintained in the auxiliary container 5, which means that the initial pressure on the inlet side of the rotor 1 also remains substantially constant with the result that the dispensing device is very accurate in operation, even at low rotational 65 speeds of the rotor.

When the bottle 21 is empty, it may be replaced by a new one without interrupting the dispensing operation. During the replacement of the bottle, the pump operates with the liquid which is still present in the auxiliary container 5. 70

As a result of the frusto-conical shape of the rotor 1, any air inclusions in the liquid can easily be removed by lifting slightly the assembly consisting of the motor 11, shaft 12 and rotor 1 and lowering it again. 75

The liquid in the auxiliary container 5, which may sometimes be of an aggressive nature, cannot reach the motor 11 because liquid splashed up in the container 5 is intercepted by the plate 13 and is propelled centrifugally thereby against the rim 14 of this plate, whence it falls back onto the cover plate 6. This liquid can then flow back in to the container 5 through aperture 22 in the cover plate. 80 85

WHAT WE CLAIM IS:—

90 1. A device for continuously dispensing a liquid at an accurately determined, very low rate, comprising a rotor surrounded by a housing and coupled to a driving mechanism, the rotor and the housing having co-operating surfaces in one of which at least one helical pumping groove is formed, wherein the device is constructed to operate with the axis of the rotor in a vertical position, one end of the housing being closed 100 by a wall having an outlet aperture and the other end opening into an auxiliary container for the liquid to be dispensed, which container has an air inlet and is arranged to lie above the rotor housing 105 when the device is positioned for use and comprises a cover plate incorporating first and second tubes which are arranged to extend downwards into the auxiliary container when the device is positioned for use, 110 the first tube extending further into the container than the second tube and the latter being wider than the first tube, and the end of the second tube that is situated in the auxiliary container being constructed 115 so that its edge lies in a plane which is inclined to the horizontal when the device is positioned for use, and means being provided for connecting the two tubes to a closed container for the liquid to be dispensed. 120

2. A dispensing device as claimed in claim 1, wherein the driving mechanism is constituted by an electric motor which is arranged on the cover plate and is coupled 125 to the motor by a flexible shaft.

3. A dispensing device as claimed in claim 1 or 2, wherein said surface of the rotor is frusto-conical.

4. A dispensing device as claimed in claim 2 or claims 2 and 3, wherein said shaft passes through the cover plate and comprises between the cover plate and the driving mechanism a dish-like plate of which the rim is directed towards the cover plate.
5. A dispensing device constructed and arranged to operate substantially as herein described with reference to the accompanying drawing.
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COMPLETE SPECIFICATION

1. SHEET

*This drawing is a reproduction of
the Original on a reduced scale*

